

## WHAT IS CLAIMED IS:

- 5        1.     A method of providing a protective coating to a substrate, said method comprising the steps of:  
              pad printing a curable protective coating onto a substrate, wherein the curable protective coating comprises at least one adhesion promoter selected from the group consisting of glycol ethers, glycol ether acetates, benzotriazole, a silane, and combinations thereof.
- 10        2.     The method of claim 1, further comprising the step of:  
              exposing the curable protective coating to sufficient radiation to form a cured protective coating.
- 15        3.     The method of claim 2, wherein the radiation is generated by an infrared (IR) light source, an ultraviolet (UV) light source, or a combination thereof.
- 20        4.     The method of claim 1, further comprising the step of:  
              pre-treating a surface to be coated on the substrate, wherein the step of pre-treating comprises one or more of the following steps:
- 25                (i)     contacting the surface with an aqueous pH neutral soap solution;
- (ii)     contacting the surface with a trisodium phosphate (TSP) solution;
- (iii)    contacting the surface with an aqueous acidic solution;
- 30                (iv)    contacting the surface with a rinse of deionized water;
- (v)     drying the surface after exposing the surface to one or more liquids;
- (vi)    exposing the surface to a corona discharge process;
- 35                (vii)   scrubbing the surface with an abrasive material prior to or during exposure to fluid including liquid, air, or a combination thereof;
- (viii)   storing the substrate in a clean, dry, enclosed container to prevent contamination from dust or other particles;
- 40                (ix)    applying a primer coating onto the surface;
- (x)     removing any excess primer coating from the surface; and

(xi) drying a primer coating on the surface.

5        5.     The method of claim 1, wherein the substrate comprises a plastic, a metal, a metal-coated plastic substrate, a glass, or a combination thereof.

10       6.     The method of claim 4, wherein the substrate comprises a plastic selected from the group consisting of polymethylmethacrylate (PMMA), polycarbonate, polyethylene terephthalate (PET), nylon, polyester, polypropylene, polyethylene, and combinations thereof; and the step of pre-treating comprises:

                  (i)     contacting the surface with an aqueous pH neutral soap solution;  
                  (ii)     contacting the surface with a rinse of  
15        deionized water; and  
                  (iii)    drying the surface after exposing the surface to one or more liquids.

20       7.     The method of claim 1, wherein the substrate comprises a metal substrate, and the step of pre-treating comprises:

                  (i)     contacting the surface with an aqueous pH neutral soap solution;  
                  (ii)     contacting the surface with a trisodium phosphate (TSP) solution;  
25        (iii)    contacting the surface with an aqueous acidic solution;  
                  (iv)    contacting the surface with a rinse of deionized water; and  
                  (v)     drying the surface after exposing the surface  
30        to one or more liquids.

8.     The method of claim 7, wherein the substrate comprises an aluminum substrate.

35       9.     The method of claim 1, wherein the substrate comprises a metal-coated plastic substrate, and the step of pre-treating comprises:

                  (i)     contacting the surface with an aqueous pH neutral soap solution;  
                  (ii)     contacting the surface with a trisodium  
40        phosphate (TSP) solution;  
                  (iii)    contacting the surface with a rinse of deionized water;

- (iv) drying the surface after exposing the surface to one or more liquids;
- (v) applying a primer coating onto the surface;
- (vi) removing any excess primer coating from the surface; and
- (vii) drying the primer coating on the surface.

10. The method of claim 1, wherein the substrate comprises a metal selected from the group consisting of brass, bronze, copper, and combinations thereof; and the step of pre-treating comprises:

- (i) contacting the surface with an aqueous pH neutral soap solution;
- (ii) contacting the surface with a rinse of deionized water;
- (iii) drying the surface after exposing the surface to one or more liquids;
- (iv) optionally, scrubbing the surface with an abrasive material prior to or during exposure to fluid including liquid, air, an acidic solution, or a combination thereof; and
- (v) contacting the surface with an aqueous acidic solution.

11. The method of claim 1, wherein the curable protective coating further comprises at least one polymerizable material selected from the group consisting of dipentaerythritol hydroxy pentaacrylate (DPHPA); tripropylene glycol diacrylate (TRPGDA); an aliphatic urethane hexaacrylate; an acrylic functional, polyester modified dimethylpolysiloxane; and combinations thereof.

12. The method of claim 11, wherein the curable protective coating further comprises at least one polymerization initiator.

13. The method of claim 9, wherein the primer coating comprises at least one silane.

14. The method of claim 13, wherein the at least one silane comprises 3-methacryloxypropyltrimethoxysilane, N-(n-butyl) 3-aminopropyltrimethoxysilane, 3-glycidyloxypropyltrimethoxy silane, 3-mercaptopropyltrimethoxysilane, vinyltriethoxysilane, and combinations thereof.

15. The method of claim 6, wherein the adhesion promoter comprises propylene glycol methyl ether acetate, and the curable protective coating further comprises:
- 5                   dipentaerythritol hydroxy pentaacrylate (DPHPA);  
                  tripropylene glycol diacrylate (TRPGDA);  
                  an aliphatic urethane hexaacrylate;  
                  an acrylic functional, polyester modified  
dimethylpolysiloxane; and  
                  at least one polymerization initiator selected from the  
10                  group consisting of thermal initiators, photoinitiators, and  
                  combinations thereof.
16. The method of claim 7, wherein the adhesion promoter comprises propylene glycol methyl ether acetate, and the curable protective coating further comprises:
- 15                   dipentaerythritol hydroxy pentaacrylate (DPHPA);  
                  tripropylene glycol diacrylate (TRPGDA);  
                  an aliphatic urethane hexaacrylate;  
                  an acrylic functional, polyester modified  
20                  dimethylpolysiloxane;  
                  a silane; and  
                  at least one polymerization initiator selected from the  
                  group consisting of thermal initiators, photoinitiators, and  
                  combinations thereof.
- 25                  17. The method of claim 16, wherein the silane comprises 3-methacryloxypropyltrimethoxysilane.
- 30                  18. The method of claim 9, wherein the primer coating comprises a  
                  silane and at least one acid; the adhesion promoter comprises  
                  propylene glycol methyl ether acetate, and the curable protective  
                  coating further comprises:
- 35                   dipentaerythritol hydroxy pentaacrylate (DPHPA);  
                  tripropylene glycol diacrylate (TRPGDA);  
                  an aliphatic urethane hexaacrylate;  
                  an acrylic functional, polyester modified  
dimethylpolysiloxane; and  
                  at least one polymerization initiator selected from the  
                  group consisting of a thermal initiator, a photoinitiator, and  
40                  combinations thereof.

19. The method of claim 18, wherein the silane comprises 3-methacryloxypropyltrimethoxysilane, and the at least one acid comprises phosphoric acid.
- 5        20. The method of claim 10, wherein the adhesion promoter comprises benzotriazole or a combination of benzotriazole and propylene glycol methyl ether acetate, and the curable protective coating further comprises:
- 10                dipentaerythritol hydroxy pentaacrylate (DPHPA);  
                  tripropylene glycol diacrylate (TRPGDA);  
                  an aliphatic urethane hexaacrylate;  
                  an acrylic functional, polyester modified  
dimethylpolysiloxane; and  
                  at least one polymerization initiator selected from the  
15        group consisting of thermal initiators, photoinitiators, and combinations thereof.
- 20        21. The method of claim 1, wherein the curable protective coating comprises less than 20 percent by weight of volatile material, based on a total weight of the curable protective coating.
- 25        22. The method of claim 1, wherein the curable protective coating comprises less than 3.0 percent by weight of volatile material, based on a total weight of the curable protective coating.
- 30        23. The method of claim 1, wherein the substrate forms at least a portion of an object, said object comprising an optical lens, eyeglasses, a contact lens, a credit card, a cellphone display, an automotive display, a personal data assistant (PDA), a pager, a video game, or a part having an optically clear component.
- 35        24. A pad printable curable protective coating comprising:  
                  at least one adhesion promoter selected from the group  
                  consisting of glycol ethers, glycol ether acetates, benzotriazole, a  
silane, and combinations thereof;  
                  at least one polymerizable material selected from the  
group consisting of dipentaerythritol hydroxy pentaacrylate (DPHPA);  
40        tripropylene glycol diacrylate (TRPGDA); an aliphatic urethane hexaacrylate; an acrylic functional, polyester modified dimethylpolysiloxane; and combinations thereof; and  
                  at least one polymerization initiator;

wherein the curable protective coating contains less than 20 percent by weight of volatile material, based on a total weight of the curable protective coating.

5        25. A cured protective coating formed by exposing the pad printable curable protective coating of claim 24 to radiation.

10       26. An object having on a surface thereof the pad printable curable protective coating of claim 24.

10       27. The object of claim 26; wherein the object comprises an optical lens, eyeglasses, a contact lens, a credit card, a cellphone display, an automotive display, a personal data assistant (PDA), a pager, a video game, or a part having an optically clear component.

15       28. The object of claim 26, wherein the object comprises a plastic, a metal, a metal-coated plastic substrate, a glass, or a combination thereof.

20       29. The object of claim 26, wherein the object comprises a plastic selected from the group consisting of polymethylmethacrylate (PMMA), polycarbonate, polyethylene terephthalate (PET), nylon, polyester, polypropylene, polyethylene, and combinations thereof; and the curable protective coating comprises:

25                propylene glycol methyl ether acetate;  
                 dipentaerythritol hydroxy pentaacrylate (DPHPA);  
                 tripropylene glycol diacrylate (TRPGDA);  
                 an aliphatic urethane hexaacrylate;  
                 an acrylic functional, polyester modified  
30       dimethylpolysiloxane; and at least one  
                 polymerization initiator selected from the group  
         consisting of thermal initiators, photoinitiators, and combinations  
         thereof.

35       30. The object of claim 26, wherein the object comprises an aluminum substrate, and the curable protective coating comprises:

40                propylene glycol methyl ether acetate;  
                 dipentaerythritol hydroxy pentaacrylate (DPHPA);  
                 tripropylene glycol diacrylate (TRPGDA);  
                 an aliphatic urethane hexaacrylate;

an acrylic functional, polyester modified  
dimethylpolysiloxane;  
a silane; and  
at least one polymerization initiator selected from the  
group consisting of thermal initiators, photoinitiators, and  
combinations thereof.

31. The object of claim 30, wherein the silane comprises 3-methacryloxypropyltrimethoxysilane.

32. The object of claim 26, wherein the object comprises a metal-coated plastic substrate having a primer coating between the metal-coated plastic substrate and the curable protective coating, said primer coating comprising a silane and at least one acid; and said curable protective coating comprising:

propylene glycol methyl ether acetate;  
dipentaerythritol hydroxy pentaacrylate (DPHPA);  
tripropylene glycol diacrylate (TRPGDA);  
an aliphatic urethane hexaacrylate;  
an acrylic functional, polyester modified  
dimethylpolysiloxane; and  
at least one polymerization initiator selected from the  
group consisting of thermal initiators, photoinitiators, and  
combinations thereof.

33. The object of claim 32, wherein the silane comprises 3-methacryloxypropyltrimethoxysilane, and the at least one acid comprises phosphoric acid.

34. The object of claim 26, wherein the object comprises a metal selected from the group consisting of brass, bronze, copper, and combinations thereof; and the curable protective coating comprises:

benzotriazole or a combination of benzotriazole and  
propylene glycol methyl ether acetate;  
dipentaerythritol hydroxy pentaacrylate (DPHPA);  
tripropylene glycol diacrylate (TRPGDA);  
an aliphatic urethane hexaacrylate;  
an acrylic functional, polyester modified  
dimethylpolysiloxane; and

at least one polymerization initiator selected from the group consisting of thermal initiators, photoinitiators, and combinations thereof.

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